CLAIMS

What is claimed is:

1. A method for determining an exponential decay rate of a signal in the presence of noise, said method comprising:

receiving an exponentially decaying signal from a detector;

digitizing said signal to form a first array of data points;

estimating a baseline value of said signal by averaging a final fraction of said data points;

subtracting said baseline value from said first array to generate a second array;

identifying a last data point on said second array occurring before a negative or nil valued data point on said second array;

scaling an ordinate value of said last data point by a factor greater than unity to determine a new first data point for a baseline fit on said first array;

fitting remaining data on said first array to a straight line to determine an estimate for a sloping baseline and said noise;

subtracting said straight line from said data points to establish a resulting array;

identifying a last data point on said resulting array occurring before a negative or nil valued data point on said resulting array;

performing a logarithmic transformation of said resulting array up to said last data point on said resulting array; and

determining said decay rate of said signal.

2. The method of claim **1** wherein said determining step includes determining said decay rate of said signal by a weighted least squares fit to said transformed data.

3. The method of claim **2** wherein said weighted least squares fit includes weighting each transformed data point inversely proportional to a square of said value of said digitized signal minus said estimated baseline value.

4. The method of claim **1** wherein said signal is generated in a ring-down cell.

5. The method of claim **4** wherein said ring-down cell includes two or more mirrors in any geometry that produces a stable optical cavity.

6. The method of claim **1** wherein said detector includes a photodector.

7. The method of claim **1** further comprising removing transient points from said first array.

8. The method of claim **1** wherein said subtracting a baseline value includes substracting a DC level.

9. The method of claim **7** wherein said subtracting a baseline value includes substracting a DC level.

10. The method of claim **1** wherein said noise includes broadband noise and excess low frequency noise.

11. The method of claim **10** wherein said low frequency noise has spectral components having a period greater than four times a record length.

12. The method of claim **4** further comprising energizing said ring-down cell.

13. The method of claim **12** wherein said engerizing step includes utilizing a laser.

14. The method of claim **13** wherein said laser is a continuous wave laser.

15. The method of claim **13** wherein said laser is a pulsed laser.

16. A ring-down cavity system for determining an exponential decay rate of a signal in the presence of noise comprising:

a ring-down cavity;

a light source for injecting light into said cavity;

a dectector;

a digitizer; and

a processor for determing said decay rate by fitting a straight line to a curve associated with said decay rate at a time greater than where a negative or nil value is detected, removing undesirable data associated with said noise and logarithmically transforming said data.

17. The system of claim **16** wherein said light source is a laser.

18. The system of claim **17** wherein said laser is a pulsed laser.

19. The system of claim **17** wherein said laser is a continuous wave laser.

20. The system of claim **16** wherein said dectector is a photodectector.

21. The system of claim **16** wherein said processor for determining said decay rate further includes removing an estimated value of said noise from said signal.

22. A method for processing a data record to determine an associated decay rate of a species in the presence of noise, said method comprises:

subtracting a DC offset from said data record;

determining a time associated with a first data point occuring before a first negative or nil data point of said data record;

scaling said time by a factor greater than unity to determine an end time associated with a portion of said data record, said end time having a corresponding value;

averaging data points from said time value to the end of record;

subtracting said value from each data point from said data record to create a new data record;

determining an end point for said new data record associated with a first data point before a first negative or nil data point of said new data record;

logarithmically transforming said new data record; and

determining a decay rate from said logarithmic transform.

23. A method of measuring the decay rate of a signal having noise, said method comprising:

measuring a data signal having noise;

forming a data array having data values associated with said signal;

subtracting undesirable data values from said array;

establishing a resulting array;

testing said resulting array for a first negative or nil value;

forming a new array ending at one value before said first negative or nil value;

performing a logarithmic transformation on said new array; and

determining said decay rate from said logarithmic transformation.

24. A method for determining an exponential decay rate of a signal in the presence of noise, said method comprising:

receiving an exponentially decaying signal;

digitizing said signal;

removing an estimated noise value from said signal;

identifying a cutoff point associated with said signal;

scaling said cutoff point by a factor greater than unity;

determining a new estimated noise value;

removing said new estimated noise value from said signal;

identifying a last point of said signal before a negative or nil valued data point on said resulting array; and

performing a logarithmic transformation to determine said decay rate of said signal.